National Park Service
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Natural Resource Stewardship and Science

Annual Report on Vital Signs Monitoring of Wolf (*Canis lupus*) Distribution and Abundance in Yukon-Charley Rivers National Preserve, Central Alaska Network

2012 Report

Natural Resource Technical Report NPS/CAKN/NRTR—2012/736

This year's report is dedicated to Tom Meier, Wildlife biologist at Denali National Park 1950 – 2012. Tom did not work on the Yukon-Charley wolf project very often, but he influenced its direction in many ways. He will be sorely missed.

ON THE COVER
Tom Meier and John Burch radiocollar a wolf.

Annual Report on Vital Signs Monitoring Of Wolf (Canis lupus) Distribution and Abundance in Yukon-Charley Rivers National Preserve, Central Alaska Network

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Executive Summary

- Wolf populations have been monitored in Yukon-Charley Rivers National Preserve (YUCH) from March 1993 to present. Beginning October 2005 the project was incorporated into Central Alaska Network (CAKN) Vital signs monitoring program as a cost shared venture.
- Wolves throughout Yukon-Charley Rivers area are targeted for monitoring of abundance and distribution. All monitored packs routinely travel outside the Preserve, some extensively. This past winter, wolf captures were conducted in November 2011 and March 2012. Monitoring radiocollared packs via radio telemetry flights will occur throughout the year with a concentrated period of flights in March – April and again in September – October. All field work is conducted using 1 or 2 biologists and 1 - 3 pilots.
- In winter 2011-2012, eight more wolves in 6 packs were captured and collared. Two packs, Snowy Peak and Sheep Bluff packs, were found by snowtracking. There are at least 2 areas (Washington Creek and Webber Creek) are known to be occupied by wolves, but remains without collared wolves. Hopefully wolves from this pack can be found and captured in winter 12-13.
- A different measure was chosen 2 years ago to help make wolf management decisions quickly: the drop in counts of wolves from fall (September/October) to Spring (March and April). This year the counts dropped from 71 to 54 wolves, a decline of 24% which is in the middle of normal range of 15 previous years of data not thought to be influenced by predator control. This includes 8 wolves from the Lost Creek Pack that were shot from a helicopter in ADF&G's wolf control.
- The Fall 2011 wolf density (4.44 wolves/1000 km^2) was above the 19 year average of 4.24, this was followed by a spring 2012 density of 3.60 wolves/1000 km^2 which is above the 19 year average of 2.85. This was likely due once again to large numbers of Fortymile caribou wintering in the Charley River.
- Fall 2011 mean pack size was 7.9 wolves/ pack, above a 19 year average of 7.18.
- Fall 2011 average litter size was 3.2 pups/ pack, below an 19 year average of 3.6
- Five wolves are known to have been shot or trapped within YUCH for winter 2011-12, based on sealing records from ADF&G.
- No substantial changes in protocol are anticipated for the upcoming field season for biological year 12-13 (May 1, 2012 – April 30, 2013).

Key Words

Yukon-Charley Rivers National Preserve, wolves, *Canis lupus*, radiotelemetry, population dynamics, density estimation.

Acknowledgments

This study was funded by U.S. National Park Service Central Alaska Network (CAKN) and Yukon-Charley Rivers National Preserve, Alaska. The skilled and safe aircraft support provided during the study by S. Hamilton, D. Miller, R. Swisher, and T. Cambier is always much appreciated. None of the work gets done without the pilots, they are there for every observation and capture, and are often the unsung heroes of most wildlife survey work throughout Alaska. Both preserve and network staff reviewed the report and made several helpful comments.

Introduction

The Central Alaska Network (CAKN) has adopted a holistic view of network ecosystems and will track the major physical drivers of ecosystem change and responses of the two major components of the biota, plants and animals. Thus, CAKN has identified Fauna Distribution and Abundance as one of its top three vital signs. In general, CAKN wants to know where fauna are distributed across the landscape and to track changes in both their distribution and abundance. The Fauna Distribution and Abundance vital sign includes monitoring efforts for a suite of vertebrate species spanning the significant elevation gradient found in CAKN parks, and also including species of specific interest within each park. Wolves (*Canis lupus*), occur in all three network parks and are one of six keystone large mammal species in interior Alaska. Wolves are of great importance to people from both consumptive and non-consumptive viewpoints, and to the ecosystem as a whole. From a monitoring standpoint, wolves are considered to be good indicators of long-term habitat change within park ecosystems because they depend on healthy populations of large ungulate prey, which in turn respond to vegetation, weather and other habitat patterns across the entire landscape (Mech and Peterson 2003, Fuller et al. 2003). As a top predator, wolves can play a key role in influencing ungulate populations, and as a result may influence vegetation patterns (Miller et al. 2001, Ripple and Beschta 2003). The effects of wolves on ungulate populations may be important determinants of ungulate availability for subsistence harvest on NPS Park and Preserve lands in Alaska, and harvest by the general public on NPS Preserve lands (National Park Service 2001). NPS began this study in 1993 and has supported it annually ever since. With the incorporation into the CAKN network vital signs monitoring program in 2005, the scope of the project was expanded.

Wolves are a species specifically identified in the enabling legislation and management objectives of all three CAKN parks (U. S. Congress 1980). Wolves are important to park visitors because of the unique opportunities to view or hear wolves in Alaskan parks. While the primary objectives of wolf monitoring will be to track the distribution and abundance of wolves, a variety of accessory data will be obtained in the monitoring process that are likely to be valuable for wildlife management and research. The body of data on wolf populations in Alaska parks is of great value in developing scientific models of predator/prey systems. In heavily visited portions of the parks, managers may want to know the locations of active wolf dens and rendezvous sites so that they can be protected from disturbance. When intensive wolf harvest or wolf control take place near parks, it is important to know home range boundaries and travel patterns of wolf packs utilizing park lands. These data are used to determine and possibly mitigate impacts of wolf control activities outside the parks. Data on the genetic and morphological characteristics of wolves, obtained as a sidelight to wolf capture, are important in evaluating long-term changes in wolf populations in Alaska.

This report focuses on monitoring the wolf population that utilizes Yukon-Charley Rivers National Preserve (YUCH) (Figure 1).

Measurable Objectives

- Locate non-radiocollared wolf packs utilizing Preserve lands by snow tracking.
- Capture and radio-collar 1 -3 individuals in each wolf pack identified in the study area.
- Determine the demography (numbers, colors, age structure) of wolf packs using Preserve lands.
- Obtain morphological measurements from captured wolves.
- Obtain genotypic data (mitochondrial and microsatellite DNA) from captured wolves, conducted by Yuch Biologist Melanie Flamme, and USGS geneticist Sandy Talbot.
- Obtain immunological (disease exposure) data from captured wolves.
- Define home ranges of collared wolf packs via GPS collar data and aerial telemetry.
- Determine pack size for each collared pack in fall (early winter) and spring (late winter) each biological year (May 1 – April 30).
- Define the mosaic of wolf home ranges (population area) for estimating biannual wolf densities (fall and spring of each biological year).
- Count the total number of wolves in each radio-marked pack in fall (Sept- Oct) and spring (March – April) to calculate wolf density and the percentage of the annual drop in mean pack size over winter.
- Perform annual capture efforts to maintain coverage of radio collars in the population.
- Detect pack extinction and pack formation events in the population.
- Detect changes in wolf density over time
- Detect changes in wolf pack size over time
- Detect changes in wolf home range size over time.
- Detect changes in the morphological, immunological, and genetic makeup of the wolf population over time.

Study Area

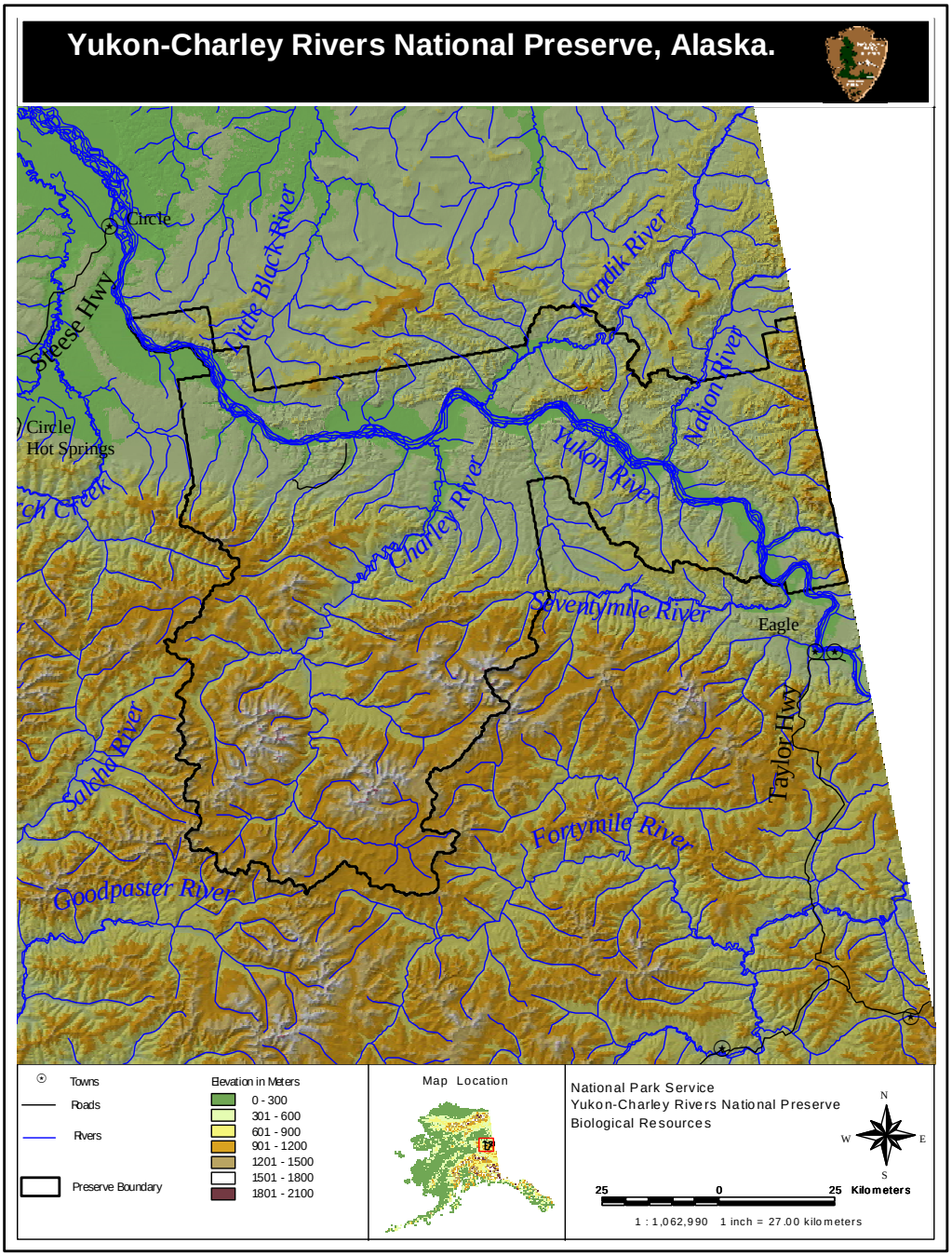

Figure 1. Wolf monitoring study area, Yukon-Charley Rivers National Preserve.

Methods

Methods followed the CAKN wolf monitoring protocol (Meier et. al. 2009) and include aerial radio telemetry, the use of GPS collars, and direct observation as primary techniques. Radiotelemetry and GPS provide the most effective way to identify and monitor individual packs and populations of wolves as well as monitoring natality, recruitment, causes and rates of mortality and dispersal, and predator – prey relationships (Mech et. al. 1998, Mech and Barber 2002).

Results and Discussion

Captures and Radio Telemetry

During November 2011 and March 2012, 8 wolves from 6 packs were captured and radio-collared in or near YUCH, 3 of which were recaptures, producing a total of 21 active collars in 10 packs. Sex and age composition of captured wolves included 4 adult males, and 4 adult females. The capture sample is biased toward adult wolves as breeding adult wolves are specifically targeted because they are less likely to disperse. Colors of captured wolves varied widely from black to 'blue' (silver gray) to various shades of gray to white. Over the history of the project weights of captured males ranged from 70-148 lbs., (32-67 kg) averaging 108 lbs (49 kg), captured females ranged from 57-130 lbs. (26–59 kg) and averaged 90 lbs (41 kg). There have been 224 wolf captures during the 19 year history of the project, 144 (64%) of them inside the Preserve boundary and 80 (36%) out (Figure 2).

We had poor snow conditions and weather for searching for uncollared packs in November 2011. However in March 2012 the Snowy Peak (Lower Kandik Area) and Sheep Bluff (Mid – upper Charley River area) packs were found and collared. Three white females were captured and colared in the Snowy Peak Pack out of at least 4 wolves in the pack and 1 black male was collared in the Sheep Bluff Pack which is looks to be a newly formed pair.

Genetics

Blood and /or tissue samples (cheek swabs and hair roots) are collected from all captured wolves for genetic analysis from both YUCH and Denali National Park and Preserve (Denali). Unique samples have been collected from over 160 individual wolves from both parks. Microsatellite data taken from the DNA extracted from these samples will be analyzed to assess the baseline levels of genetic variation in each wolf population and to determine the consistency of pack lineages. This work is conducted by Yuch Biologist Melanie Flamme, in cooperation with USGS geneticist Sandy Talbot.

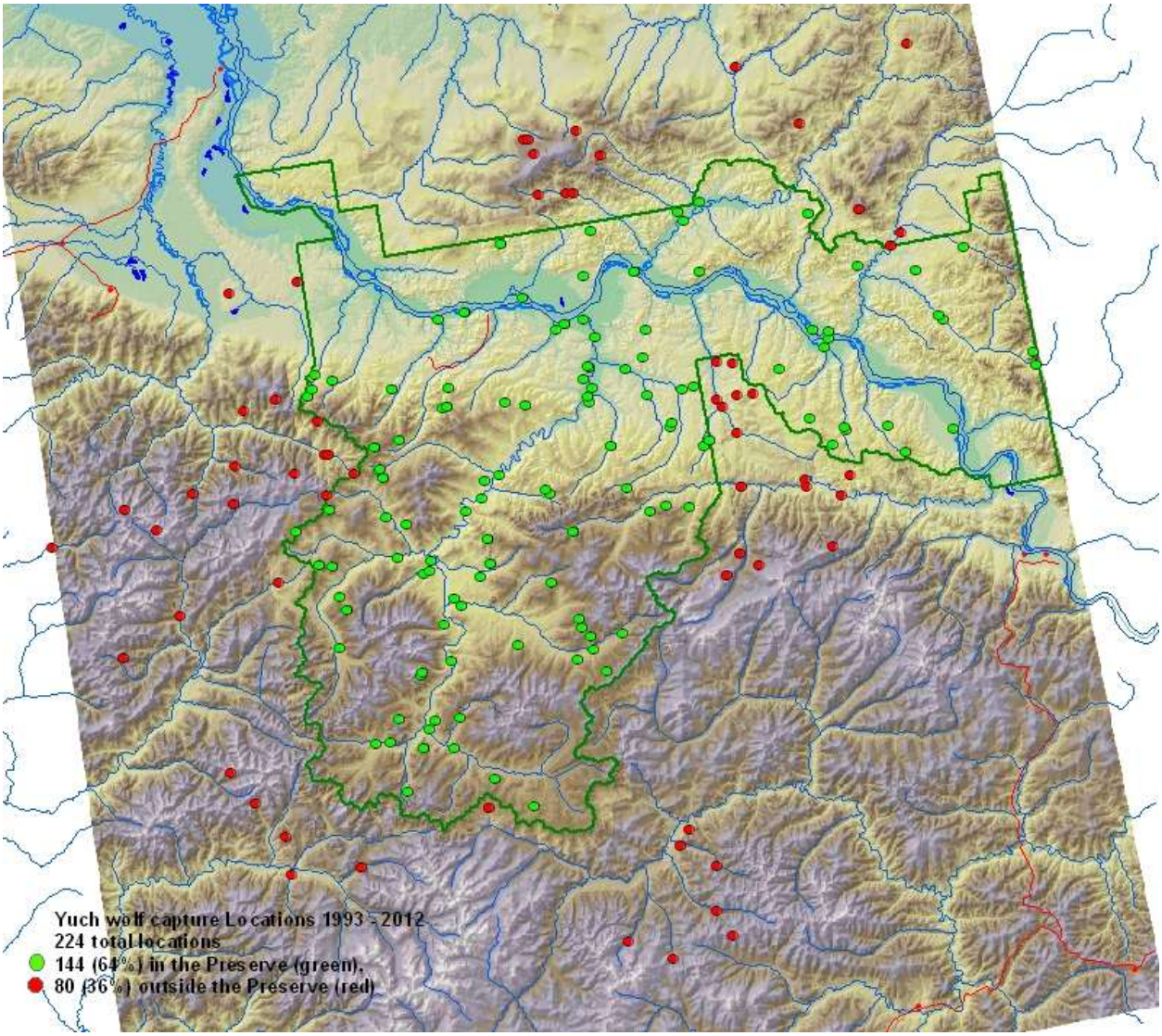

Figure 2. All wolf capture locations from 1993 – 2012. 216 total locations, 144 (64%) within the Preserve boundary, 80 (36%) outside the Preserve.

Home range Size, Movements, Density and Population Estimates

Individual home ranges, pack sizes and density estimates for Fall 2010 – Spring 2012 are shown in Figures 3 – 6. We know that packs of wolves exist in the areas of Washington Creek and Webber Creek but we were unable to capture and collar any of them. This past winter (2011 - 2012) once again all packs stayed home and none went on any type of foray (long-distance movement outside of their territory documented via the GPS collars), which is unusual. This likely occurred as a result of a large portion of the Fortymile Caribou Herd (FCH) wintering in the Charley River the past 2 winters. Forays in past years appeared to be packs of wolves following or looking for concentrations of caribou. During most winters, the FCH leave the Charley River valley (Valkenburg et al 1994) and the wolves that live there become dependent on a small number of remaining caribou and a low density moose population (Burch 2010) and likely become food stressed.

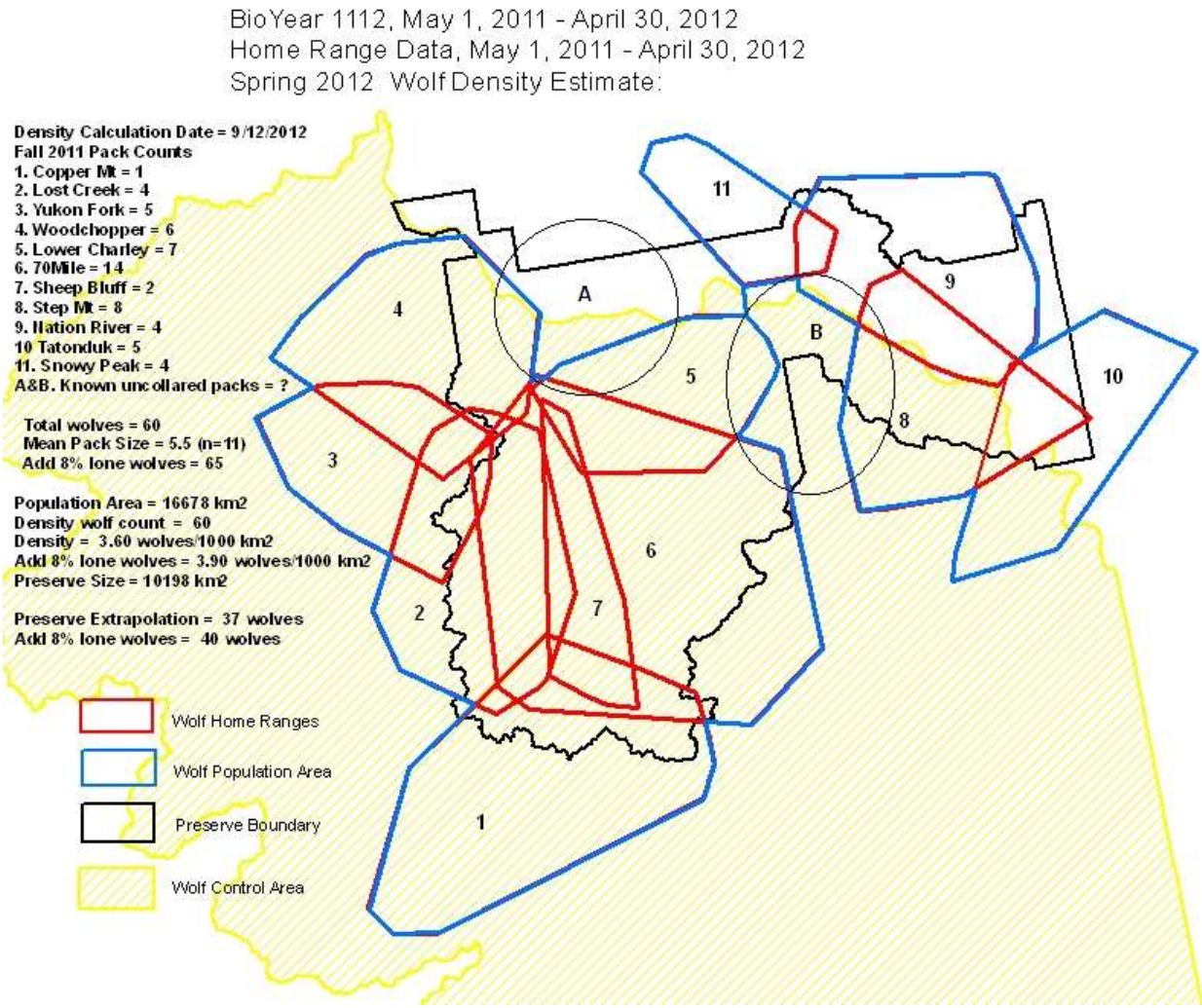

Figure 3. Spring 2012 map of individual pack home ranges, pack counts, and density calculation. Minimum convex polygons are used to delineate pack home ranges.

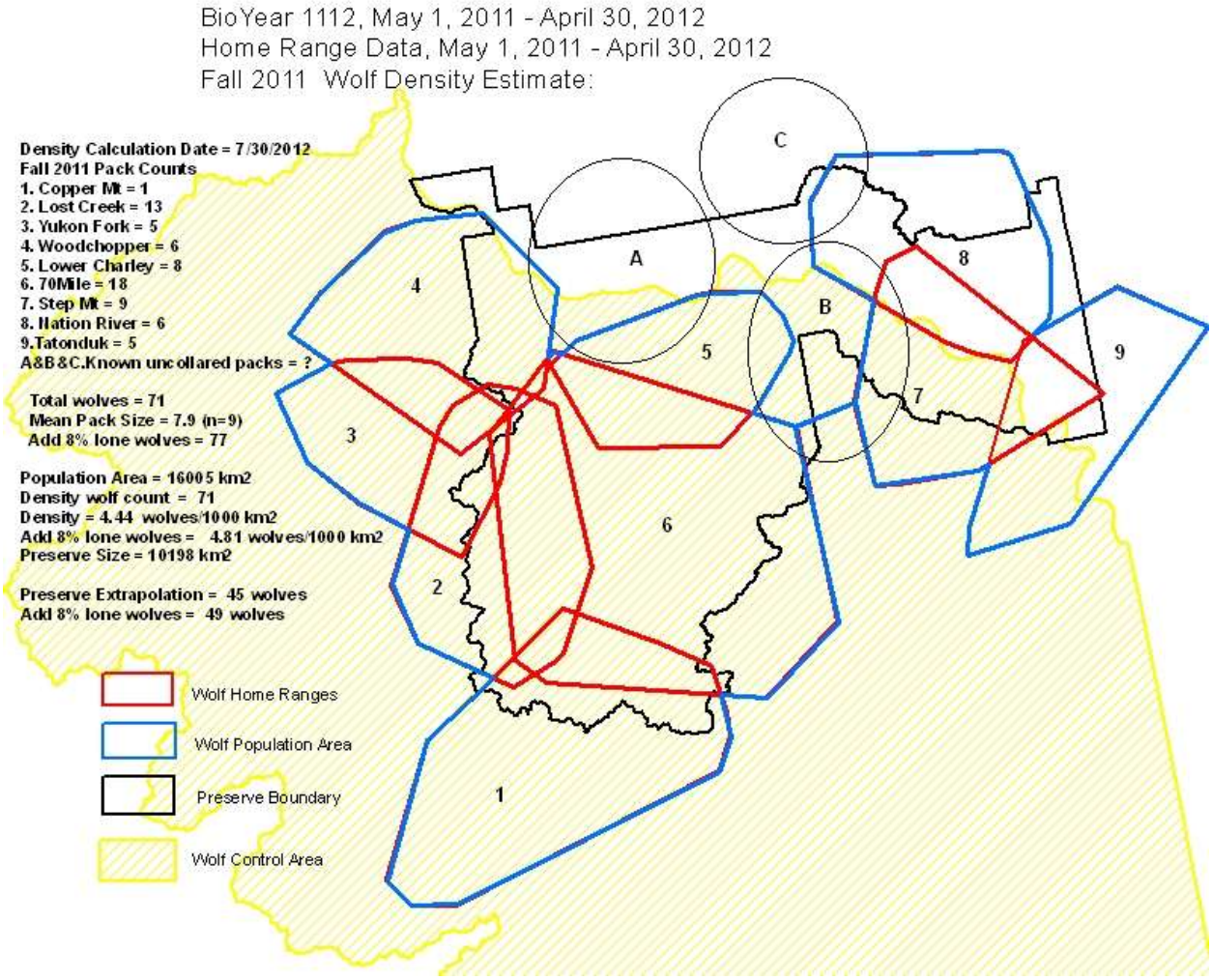

Figure 4. Fall 2011 map of individual pack home ranges, pack counts, and density calculation. Minimum convex polygons are used to delineate pack home ranges.

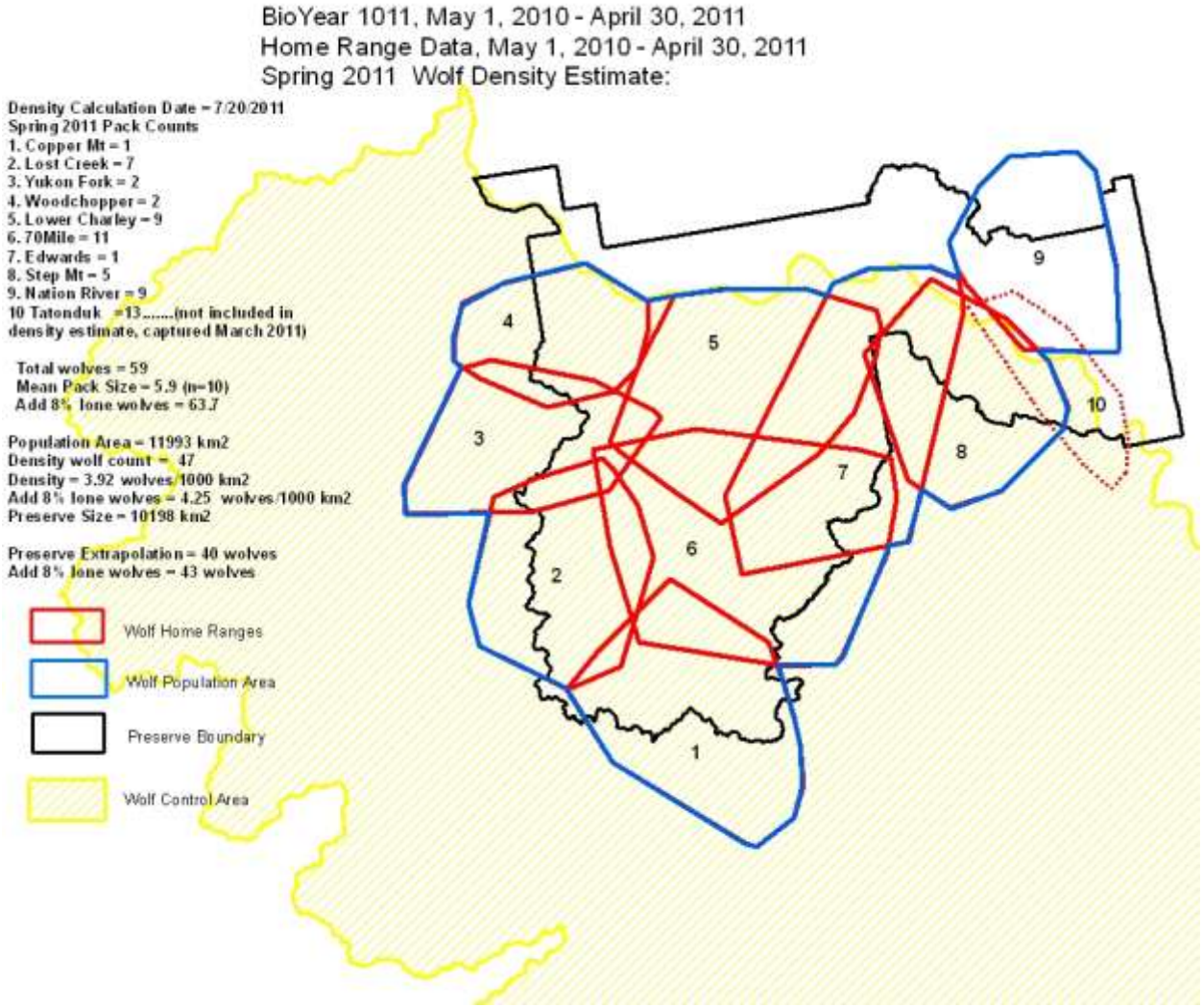

Figure 5. Spring 2011 map of individual pack home ranges, pack counts, and density calculation. Minimum convex polygons are used to delineate pack home ranges.

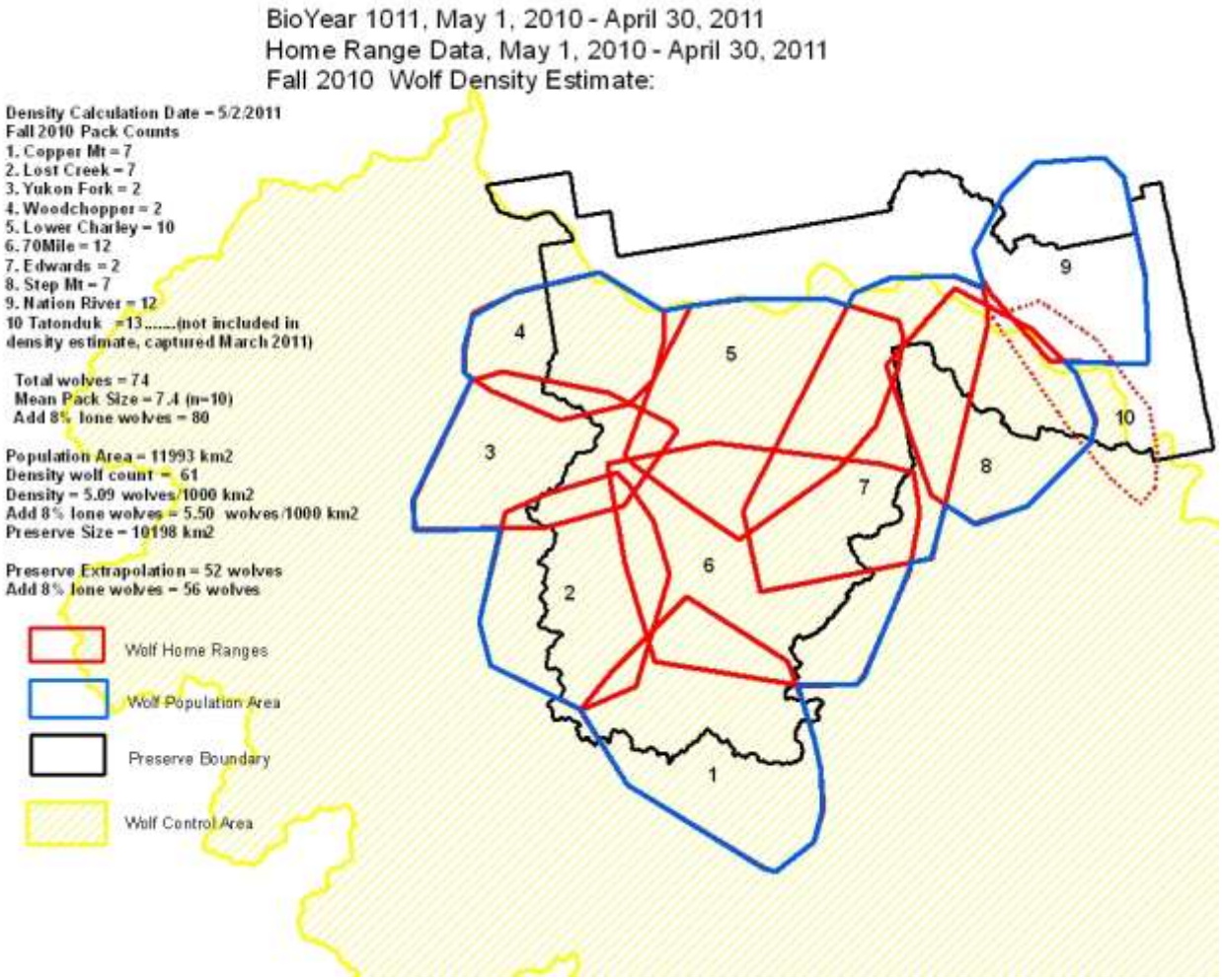

Figure 6. Fall 2010 map of individual pack home ranges, pack counts, and density calculation. Minimum convex polygons are used to delineate pack home ranges.

From 1993 - 2002, before the common use of GPS collars, home range sizes for individual Preserve packs averaged 2300 km^2 (888 mi^2) and varied from 268 – 7067 km^2. Annual mean home range size ranged from 1639 to 3253 km^2 (633 – 1256 mi^2) (Burch 2002). With the advent of GPS collars, the annual number of locations per pack has increased nearly 10 fold and with it came an increase in individual home range size (Burch et al. 2005). Home range sizes of packs containing at least one GPS collar were more than 35% larger than those found using conventional aerial telemetry (Figure 7).

In years prior to the common use of GPS collars, home range size was measured for each radiomarked pack where more than 20 locations were available in a 2 year time block. This was an attempt to overcome the problem of home range size being dependent on the sample size of locations (when calculated using Minimum Convex Polygons (MCP)). Even with this doubling of sample size the relationship still holds (r^2 = 19.4, P = 0.00017, n = 67) (Figure 8) and MPC home range size was still dependent on the number of locations (White and Garrott 1990). With

the advent of GPS collars, 1 biological year of locations is used, but the problem of home range size being dependent on sample size appears to still exist even with 300 locations per year, although the effect is much smaller.

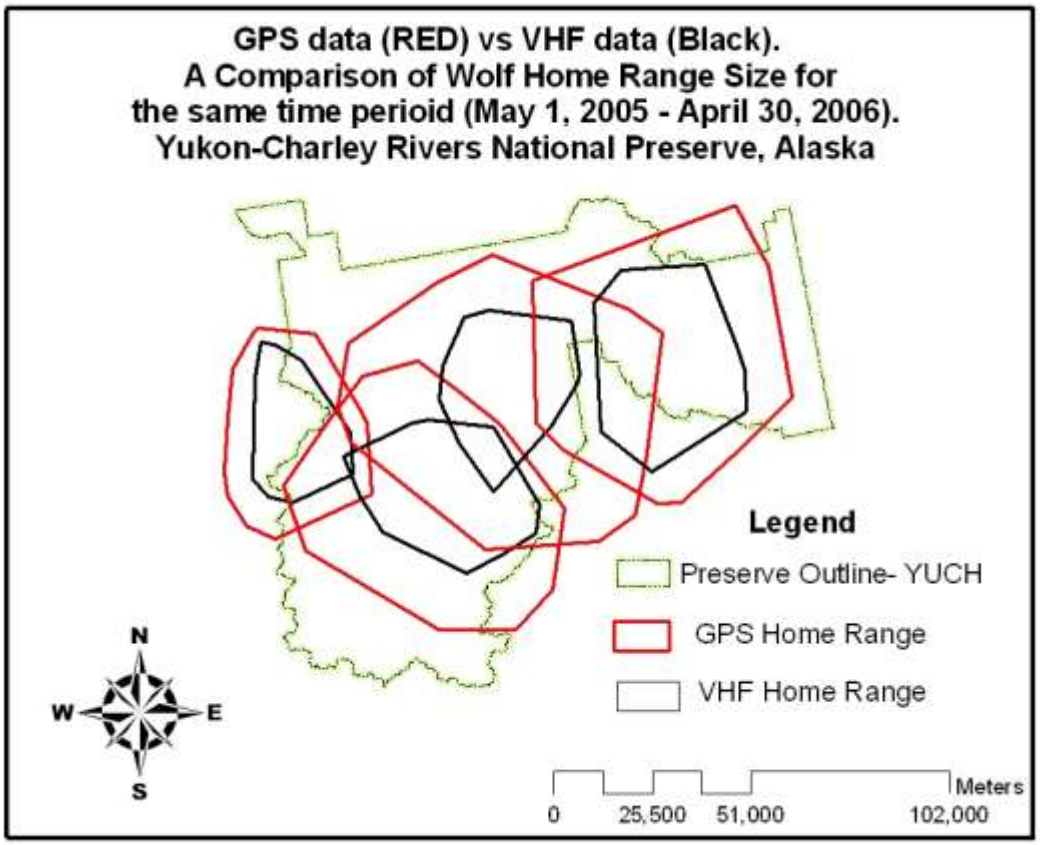

Figure 7. Wolf home ranges measured with GPS collars are over 35% larger on average than those from conventional aerial radiotelemetry (VHF) when measured over the same time period. Average GPS home range = 3322 km^2. Average VHF home Range = 1211 km^2. Not all home ranges depicted for clarity.

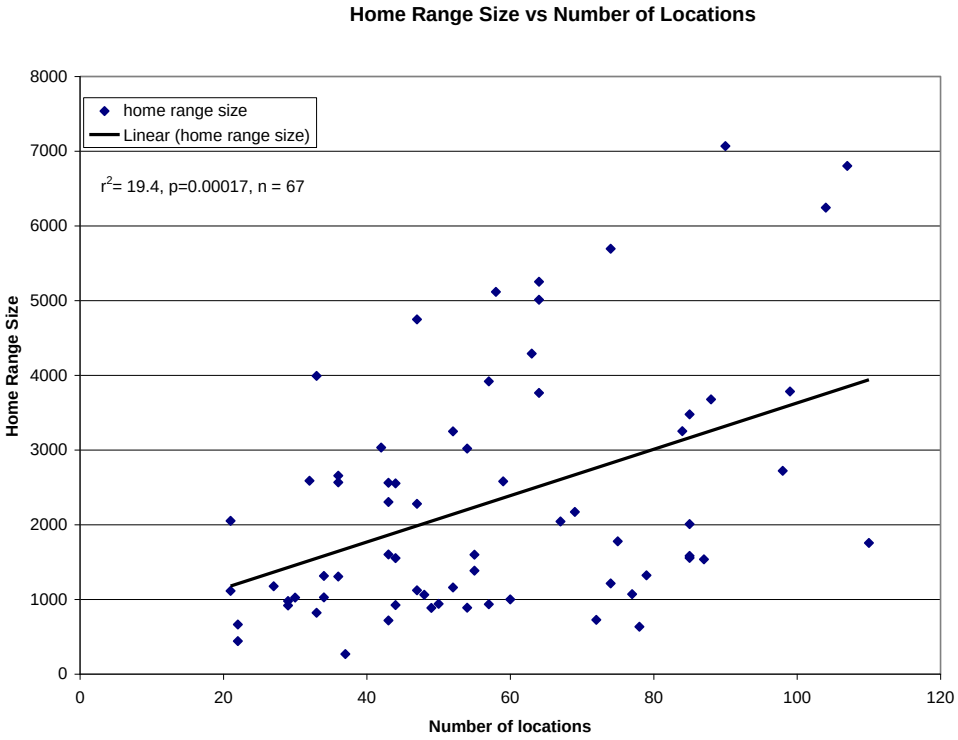

Figure 8. Wolf home range size vs. number of locations showing that home ranges calculated using minimum convex polygons are dependent on sample size of locations. Yukon-Charley Rivers National Preserve, Alaska, 1993 – 2005.

Kernel Home Range Analysis

This was the third year in which kernel analysis (Worton, 1989) was used to measure the population area in addition to minimum convex polygons (MCPs) (Figure 9). We hope to develop a more objective and consistent method for measuring annual home ranges and population area size to be used in calculating wolf density estimates. One problem with MCPs is their dependence on sample size of locations (White and Garrot 1990, Burch et al 2005), a second problem is the subjective decisions needed to remove outliers where wolves disperse or temporarily leave their home range on forays, among others. This year using the 95% Kernel for Fall 2011 produces a population area of 13453 km^2 and a density of 5.3 wolves/1000km^2 , a higher density than that obtained using the standard minimum convex polygon (MCP) method, 4.4 wolves/1000km^2 (Figure 9 vs. Figure 3). However, the decision to use the 95% kernel this year where we used the 75% isopleth last year was also subjective and was chosen as the kernel percentage producing a population area nearest to the one derived from the MCPs. As a result, we may simply be replacing one subjective decision with another. This year's Kernel analysis used a different software to produce the kernels, an Animal movement tool within the ToolBox extension of ArcGIS (ESRI), where last year the kernels were produced with routines found in the software 'R'. Comparing the 2 methods show that additional subjective decisions are involved as to what settings such as cell size, and smoothing factors can affect the area within each isopleth percentage.

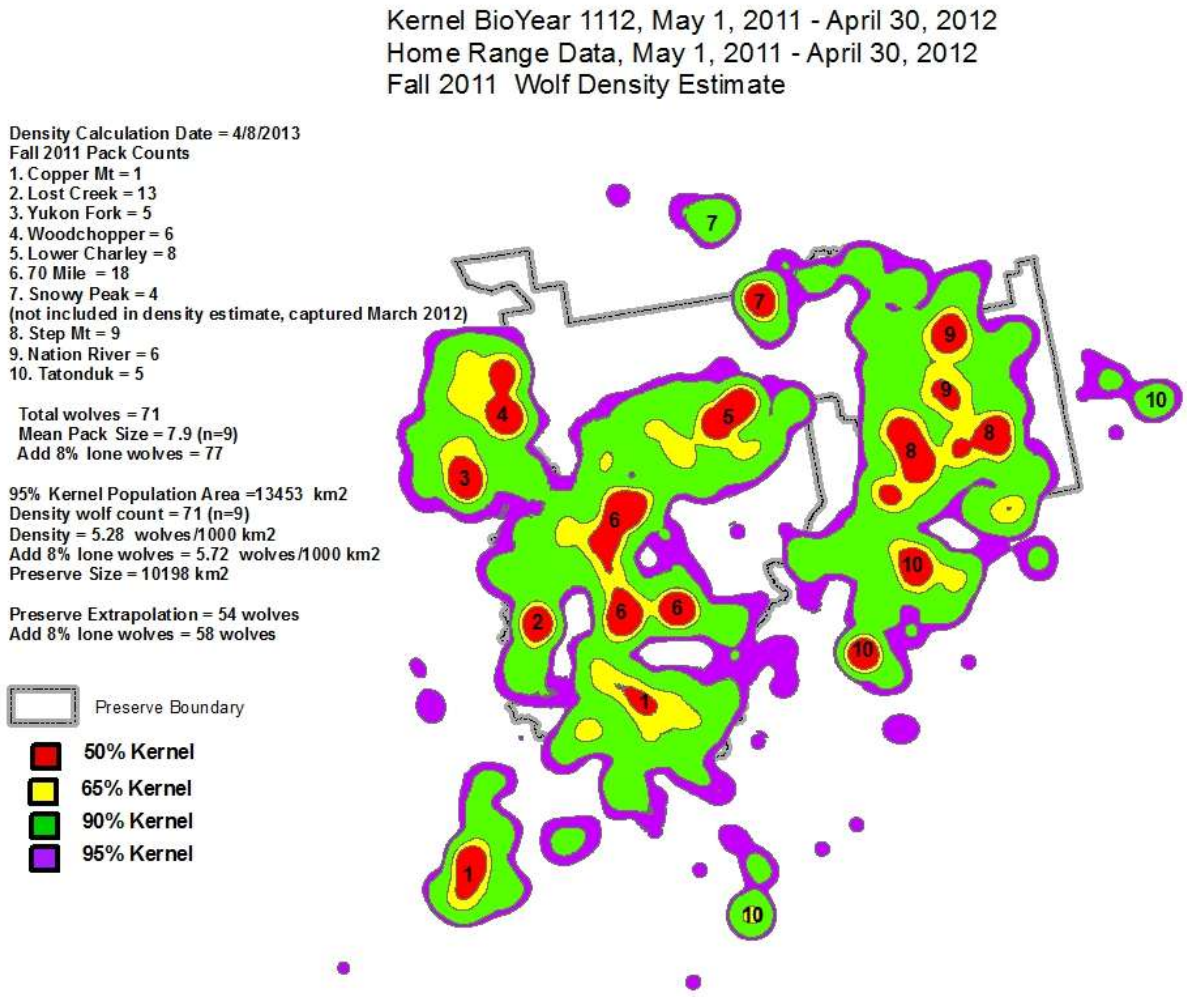

Figure 9. 50% - 95% Kernel home ranges of the Fall 2011 population areas (formed by dissolving the overlap of the isopleths for the individual packs for each percentage). The Density calculation is made from the 95% population area kernel.

Pack Sizes and Population Change

Fall mean pack sizes have ranged from 4.3 to 9.1, with a 19 year average (1993 – 2011) of 7.2 (Figure 10). The wolf population in the area continues to fluctuate and is likely responding to changes in the accessibility and vulnerability of Fortymile Caribou. From 1993 – 2001 the increasing trend in mean pack size was significant (r^2=0.59, *P*=0.015), however from 2002 on it levels out, then drops in 2005, then up and down 2008-2009 with higher numbers the past 2 years (Figure 10). Wolf densities follow the same trends as mean pack sizes (Figures 12 & 13). Most recently, the population hit an all-time low density of 1.6 wolves/1000 km^2 in spring 2007, then rebounded to almost 2.5 in spring 2008. The fall 2008 wolf density estimate was the highest calculated since the study began in 1993 at 5.86 wolves/1000 km^2. This was followed by the largest drop in population size to a spring 2009 density of 2.41 wolves/1000 km^2. This large

drop (61% when measured by mean pack size, Table 1, Figure 11) seems to be related to the State of Alaska wolf control efforts, however this is not reflected in the fates of the sample of radio collared wolves, or by what could be learned from word of mouth. The Fall 2011 density of 4.44 was just above the 19 year average of 4.23, and the Spring 2012 density of 3.60 was one of the higher spring densities, and well above the 19 year average of 2.85 (Burch 2002, 2006, 2007, 2008, 2009). This was likely due to a large portion of the Fortymile Caribou Herd remaining in the Charley River for the winter once again just like last winter. Fall densities are measured when pack sizes are at their highest and densities are greatest for the biological year and follow the same overall trend pattern as mean pack size (Figure 10). Pack sizes are actually greater right after pups are born in May, however, we cannot reliably count all the pups from airplanes in all the packs until September or October when the pups are traveling consistently with the rest of the pack and there might be some snow on the ground to increase sightability.

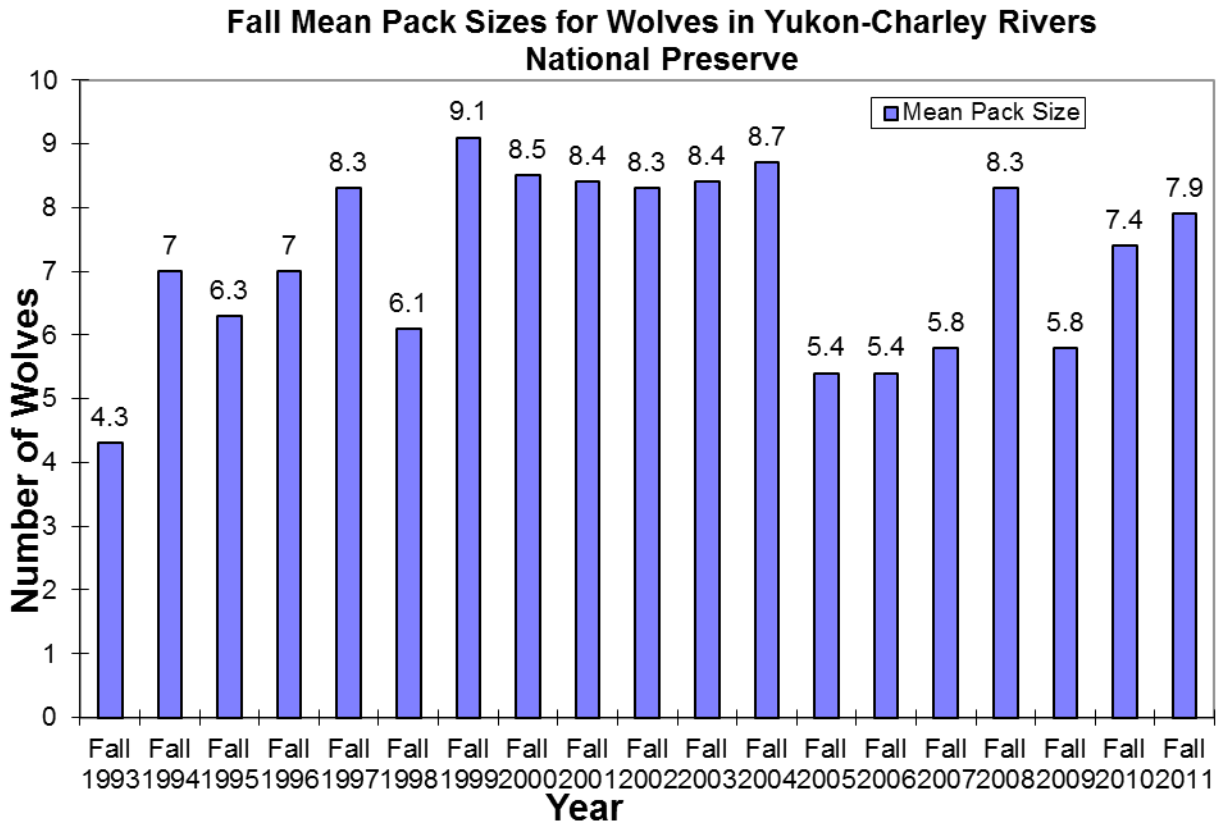

Figure 10. Trend in wolf population using Fall mean pack size, 19 year Average = 7.2. Yukon-Charley Rivers National Preserve 1993 – 2011.

In 2010 we started using different measure of wolf population change to help make management decisions quickly at any time through the year. Accurate density estimates require a full biological year (May 1 – April 30) of location/home range data to calculate the area used to make density estimates consistently from one year to the next, and even then have additional problems. As a result, density estimates calculated earlier in the year must be based on the previous year's location data and what location data is available so far from the current year.

Shifts in pack home ranges over time can result in erroneous or inaccurate density estimates. The chosen metric of wolf population change utilizes the drop in counts (or mean pack size) of radio-marked packs from fall (September/October) to Spring (March and April) or at any time in between. During biological year 2009-2010, the counts dropped from 52 to 31 wolves, a decline of 40%, the largest drop seen in 14 years of data not thought to be influenced by wolf control (Table 1). For this year (2011–2012) the counts dropped from 71 wolves to 54 wolves or a drop of 24% (Table 2) which is well within the normal range of 11%-37% (Tables 1 & 2, Figure 11). This measurement is essentially identical to the drop in wolf densities from fall to spring as reported previously in Burch (2002, page 44) but because it uses mean pack size instead of density it can be calculated quickly at any point in the biological year.

Table 1. History of changes in mean pack size for collared packs between fall and spring. This only includes packs where data are available for both seasons. The 4 years highlighted in red indicate years where predator control activities likely, (or were known) to have affected population changes and are not included the 'normal' range (green). This table was created to determine what "Normal" drops in pack counts would have been. Drops in pack counts due to unusual circumstances of sterilization and translocation by ADF&G, or unusual heavy and targeted trapping were removed as indicated in the footnotes.

Winter	Fall	Spring	Percent Drop
1993 - 1994	4.5	4	11%
1994 - 1995	7	5	29%
1995 - 1996	7.3	6	18%
1996 - 1997	10.3	7.7	25%
1997 – 1998*	8	5.6	30%
1998 – 1999	6.7	5.7	15%
1999 – 2000 **	8.2	5.5	33%
2000 – 2001**	7.9	5.3	33%
2001 - 2002	8.8	6.5	26%
2002 - 2003	8.6	7.1	17%
2003 - 2004	9.2	6.7	27%
2004 - 2005	8.7	5.5	37%
2005 - 2006	7.4	5.2	30%
2006 - 2007	4.9	2.4	51%
2007 - 2008	5.8	4	31%
2008 - 2009	7.4	2.9	61%
2009 – 2010***	5.8	3.1	46%
2010 - 2011	7.4	5.8	22%
2011 - 2012	7.9	6	24%
Range (Normal)	4.5 - 10.3	3.7 - 7.7	**0.11 - 0.37**
Average (15 normal years)	7.7	5.7	26%

red rows = years likely or known to be effected by ADF&G wolf control
*Granite Creek Pack excluded because of ADF&G sterilized and translocated.
**Unusually heavy and targeted trapping on 3FingerPack averaged to normal.
***Webber Creek Pack eliminated by ADF&G therefore included as a minimum drop

Table 2. Change in pack counts and the percent drop in size of radio collared wolf packs in Yukon-Charley Rivers National Preserve from Fall 2011 to Spring 2012.

	Pack	Fall 2011	Spring 2012	Percent Drop
1	Copper Mt	1	1	0%
2	Lost Creek *	13	4	69%
3	Yukon Fork	5	5	0%
4	Woodchopper	6	6	0%
5	Lower Charley	8	7	13%
6	70Mile	18	14	22%
7	Step Mt	9	8	11%
8	Nation River	6	4	33%
9	Tatonduk	5	5	0%
	Total wolves	71	54	24%
	Average	7.9	6.0	24%

* = 8 wolves shot from Lost Creek Pack by ADF&G wolf control

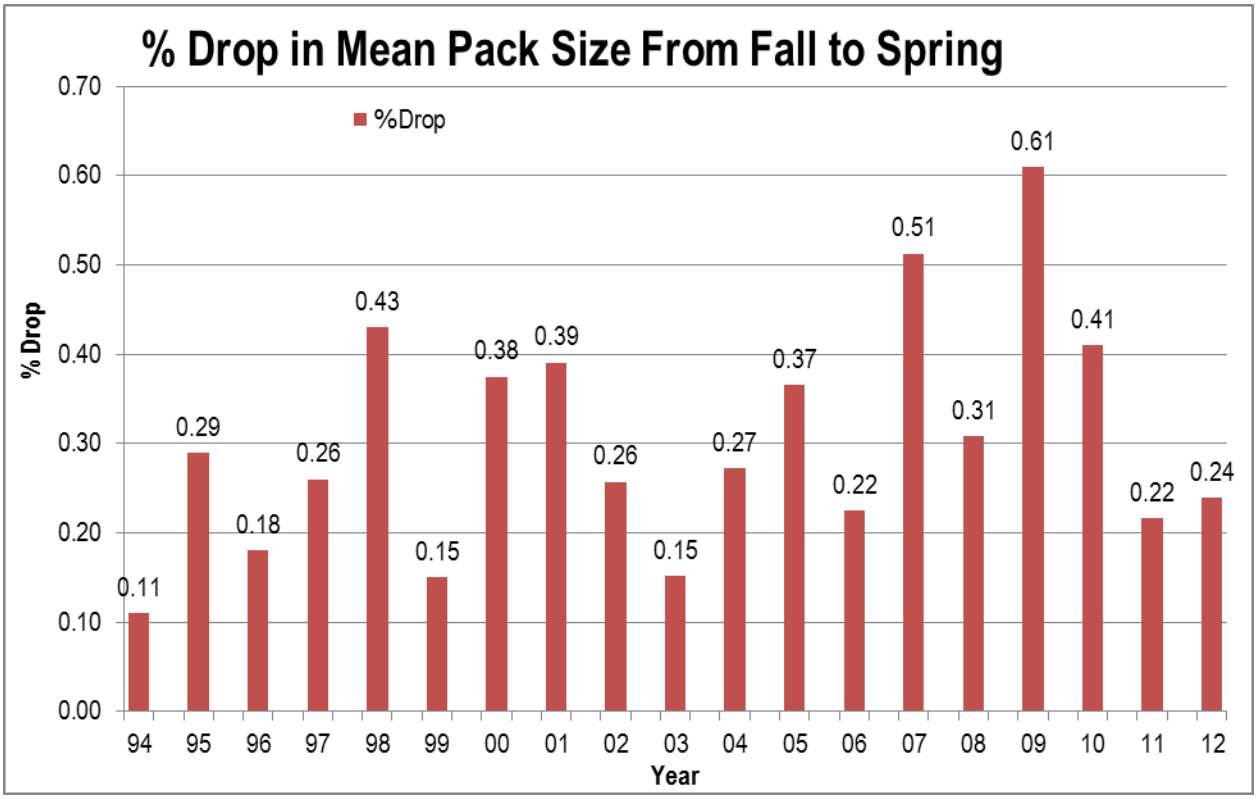

Figure 11. Drop in mean pack size (percent drop from Fall to Spring) from 1994 – 2012 using ALL data. Data depicted in this histogram will not match data in tables 1 and 2. These data include all counts of wolves including the non-normal counts where dramatic drops occurred in some packs due to ADF&G wolf control. The 19 year average = 0.31. Yukon-Charley Rivers National Preserve, Alaska.

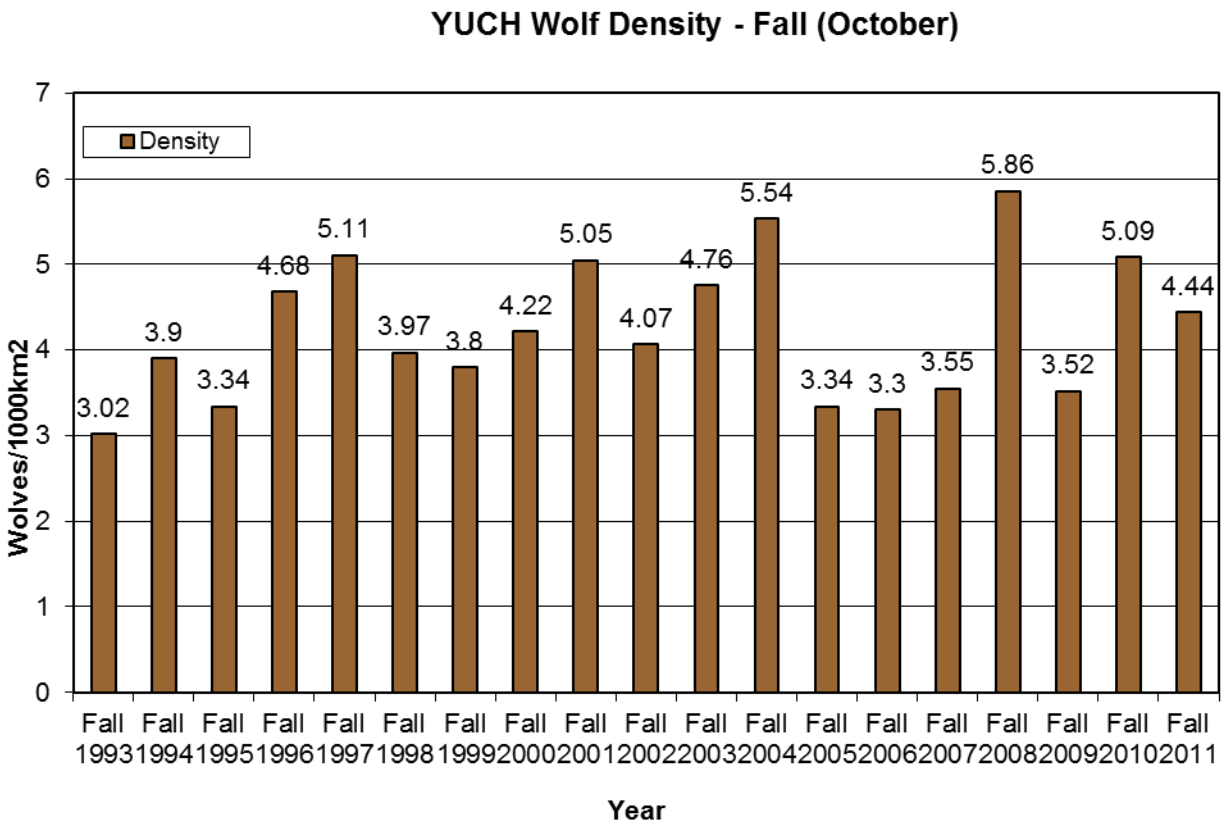

Figure 12. Fall wolf densities (wolves/1000 km^2) in YUCH 1993 – 2011. (Average=4.24).

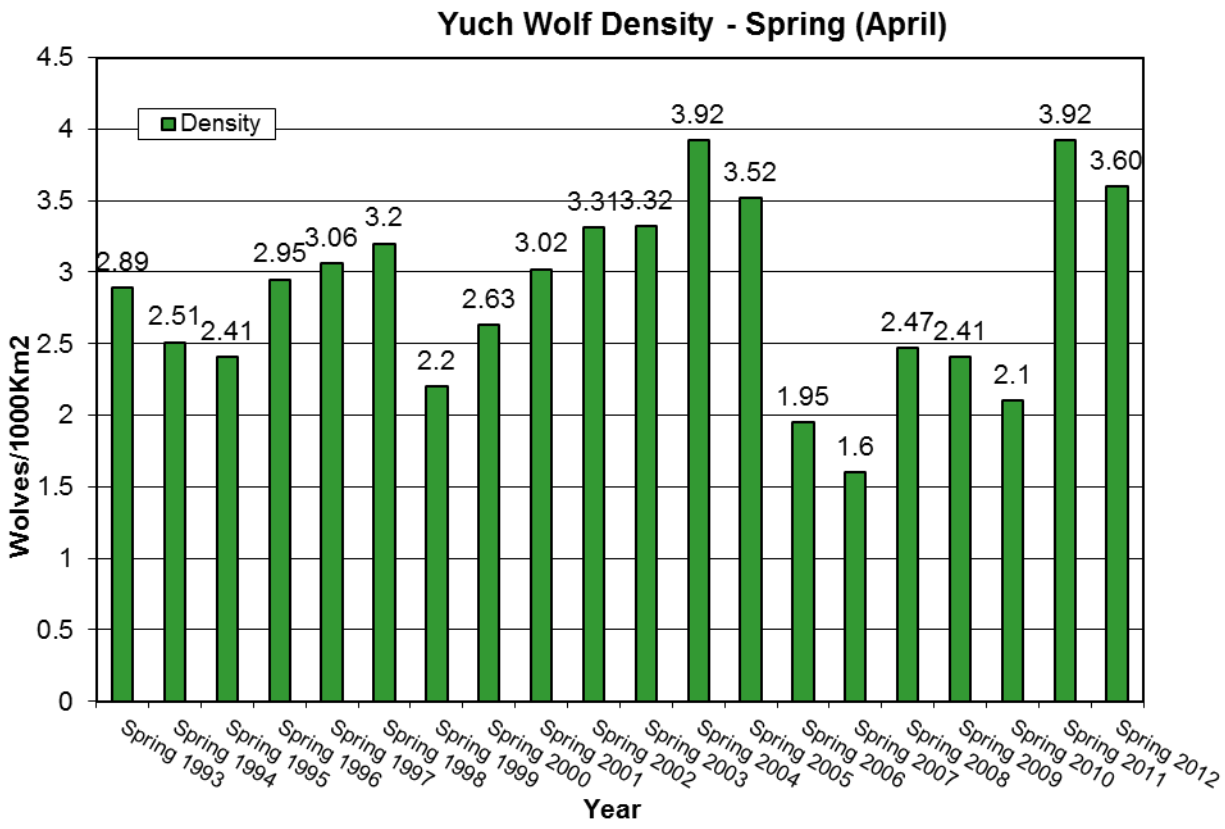

Figure 13. Spring wolf densities (wolves/1000km^2) in YUCH, 1993 – 2012 (Average= 2.85).

Fortymile Caribou

In 1920 biologist Olaus Murie estimated the Forty Mile Caribou Herd (FCH) to number 568,000 caribou, and the herd had been reported to have ranged from Whitehorse, Yukon to the White Mountains north of Fairbanks (Murie 1935, Boertje et.al. 2012). It is difficult to know how accurate Murie's estimate was as he estimated how many caribou crossed a 1 mile stretch of the Steese Highway in one day and then multiplied that number for a 40 mile stretch of highway for 20 days, which is what was reported by others to be the extent and duration of the herd's crossing the road (Murie 1935). In the 1930s the herd population dropped to an estimated 10,000 to 20,000 caribou (Valkenburg et al 1994, Boertje et.al. 2012). The cause of this dramatic decline is unknown but suspicions include overharvest, food limitations due to range depletion and fires, or other wide spread phenomena. Predation was not considered a causal factor (Valkenburg et al 1994, Boertje et.al. 2012). The most likely case is that there were nowhere near 500,000 caribou in the Fortymile herd, and Murie (1935) was wrong.

During the 1940s and 1950s the herd increased again to perhaps as many as 50,000. From an estimated 50,000 animals in 1963 the herd size dropped dramatically to 6000 animals in 1973 and Fortymile caribou stopped crossing the Steese Highway. The cause of this decline was attributed to a combination of overharvest, deep snow conditions, and predation by wolves and bears (Valkenburg et al 1994, Boertje et.al. 2012). Starting in 1976, the herd began to increase slowly, to over 22,000 by 1990, and was roughly stable at 22000 – 23000 through 1995 (Valkenburg et al 1994, Boertje and Gardner 1996). In 1994 the Fortymile Planning Team was formed and plans for wolf reductions and reduced human harvest of Fortymile caribou were made. From 1995 through 2002, the herd grew to nearly 45,000 animals (Boertje and Gardner 1996, Jeff Gross, Tok area biologist, Pers. Comm., Boertje et.al. 2012) after which it declined to just over 38,000 in 2007. The population then increased again over the next 3 years. The most recent photo census in June 2010 produced a population estimate of almost 52,000 (Boertje et.al. 2012) (Figure 14).

The drop in wolf numbers in 2005 – 2007 does not correlate well with the change in caribou numbers during the same time (Figure 14). Low snowfall winters at this time may have allowed the caribou (and moose) to be less vulnerable to wolf predation, thereby causing an increase in wolf dispersal and natural mortality and a decrease in pup production and survival (Figure 15), culminating in a drop in the wolf population for those years. Conventional human harvest levels (not including predator control efforts) at this time were lower than the 24 year annual average of about 7 wolves harvested within the Preserve (Figures 16 &18) and likely played no role in this drop in wolf numbers.

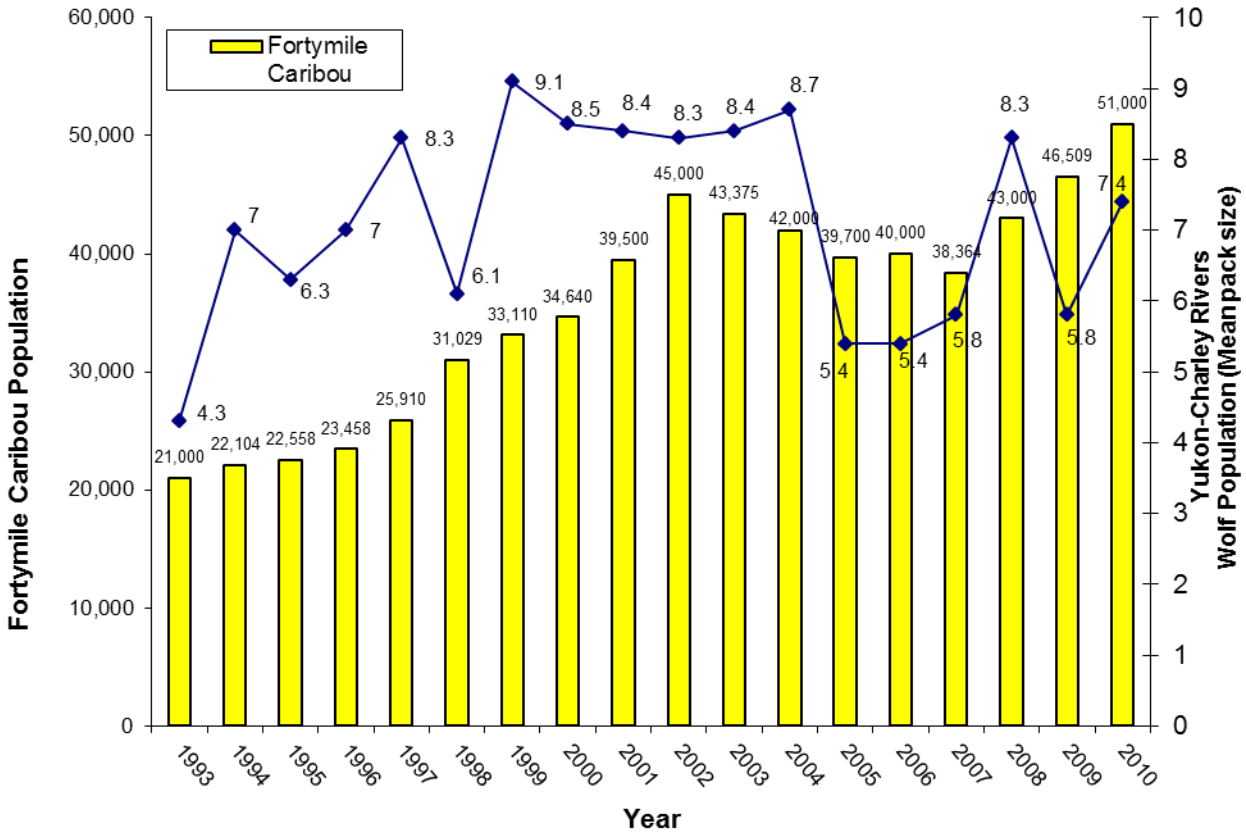

Figure 14. Trend in population change for the Fortymile Caribou Herd (trend in ADF&G's photo census counts) and wolves (Fall mean pack size) in Yukon-Charley Rivers National Preserve, Alaska, 1993 – 2010.

Natality

Pup production and survival to fall is illustrated in Figure 15. The counts of pups are from September - November of each year when the pups are still small enough to distinguish from adults from an airplane. At that time, leaf fall, snow, and the wolves (including the pups) beginning to travel more widely as a pack, make conditions more favorable for seeing and counting wolves from aircraft. Likely there are more pups born in May than are seen in the fall, and some pup mortality occurs between May and September, so these are minimum counts. The cause of the drop in pup production and/or survival in 2004 and 2005 is unknown but correlates well with the overall drop in population size from 2004 to 2006 (Figures 10 - 13).

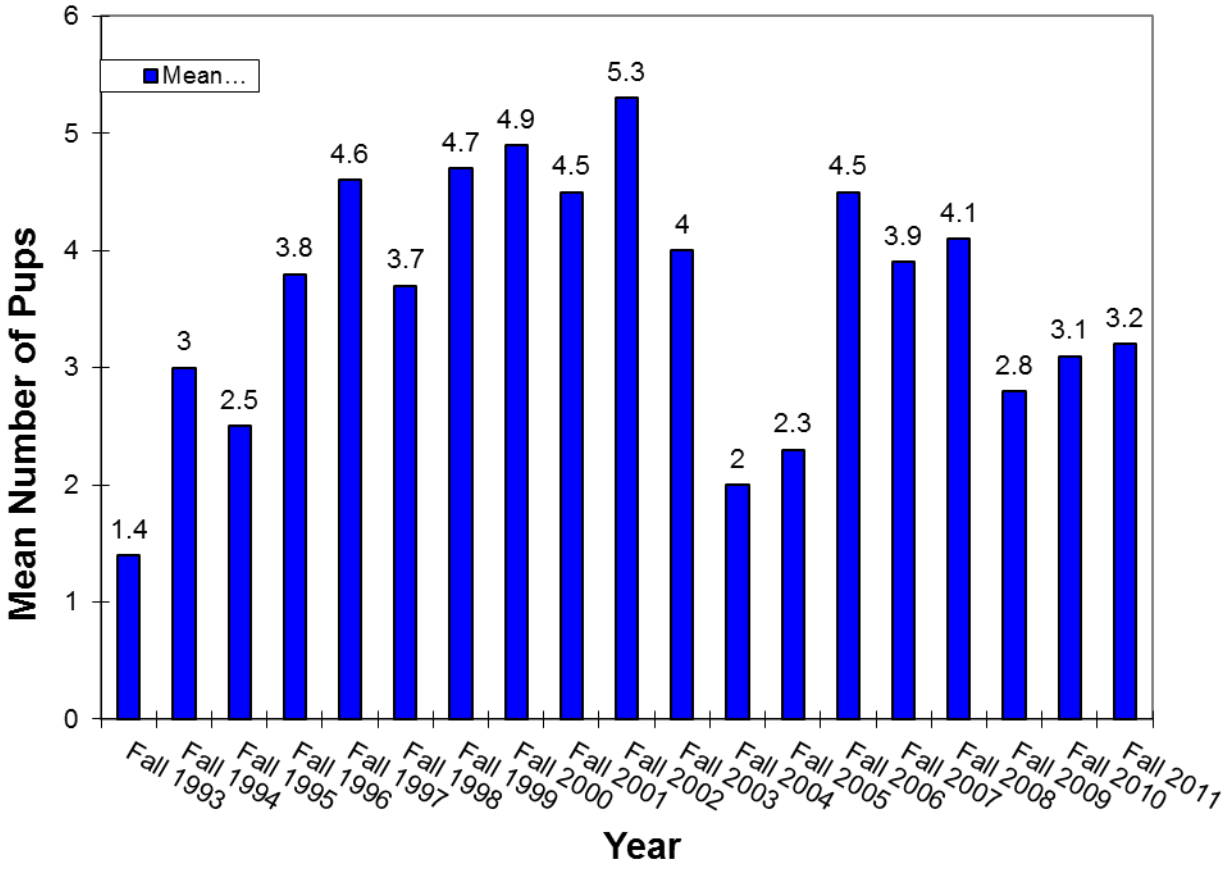

Figure 15 – Trend in Pup production and survival to fall (September/October mean litter sizes), 19 year average = 3.6.

Mortality

Fates of collared wolves

Fates of a sample of 150 radiocollared wolves (from the beginning of the project in 1993) is illustrated in Figure 16. Although the sample of collared wolves is not representative of the population, they probably give a good idea of what happens to most wolves in the YUCH population. About 15% of YUCH wolves are trapped or shot within or near the preserve by conventional methods (not wolf control) each year, and at least 28% disperse from the population. It is likely that many of the wolves in the "fate unknown" category were also dispersals. It is also likely that much of the drop in wolf numbers that occurs each year results from dispersals. The number of dispersals that are seen from a sample of radiocollared wolves is heavily biased against dispersal because the breeding pair are targeted for capture, and are the least likely to disperse, combined with likelihood that many of the wolves whose fates are 'unknown' also dispersed, illustrates how important dispersal is to wolf population change (Gese and Mech 1991). Most mortalities of collared wolves have occurred within or close to the Preserve boundary (Figure 17).

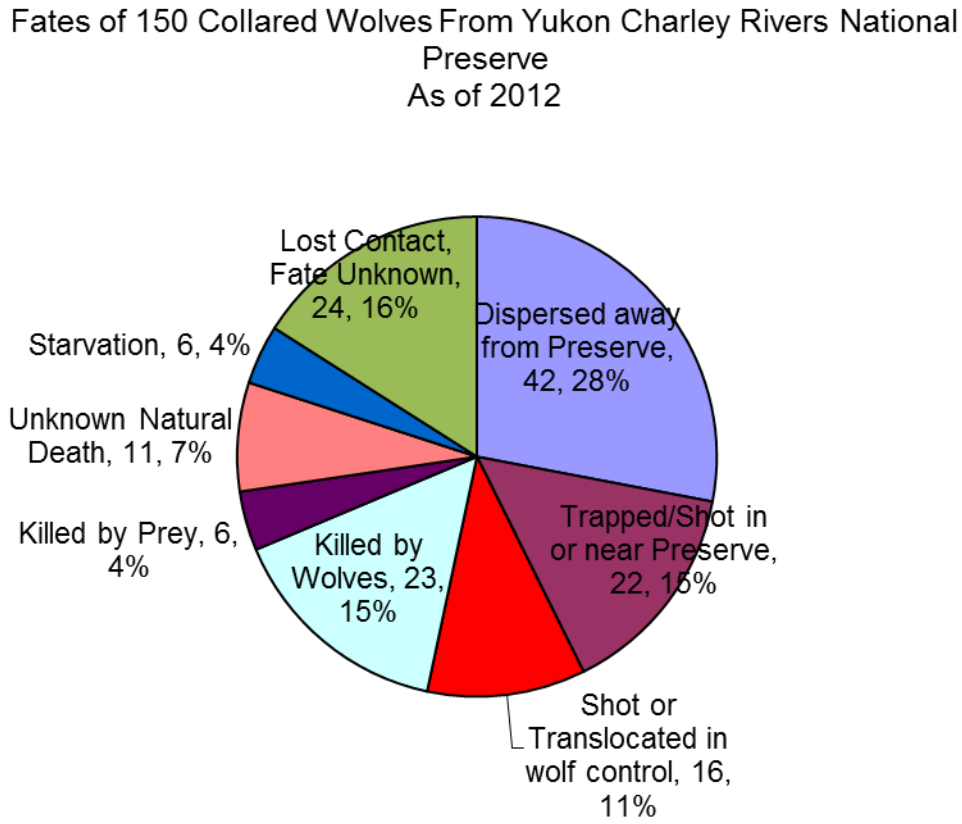

Figure 16. Fates of 150 collared wolves in and around YUCH, 1993 – 2012.

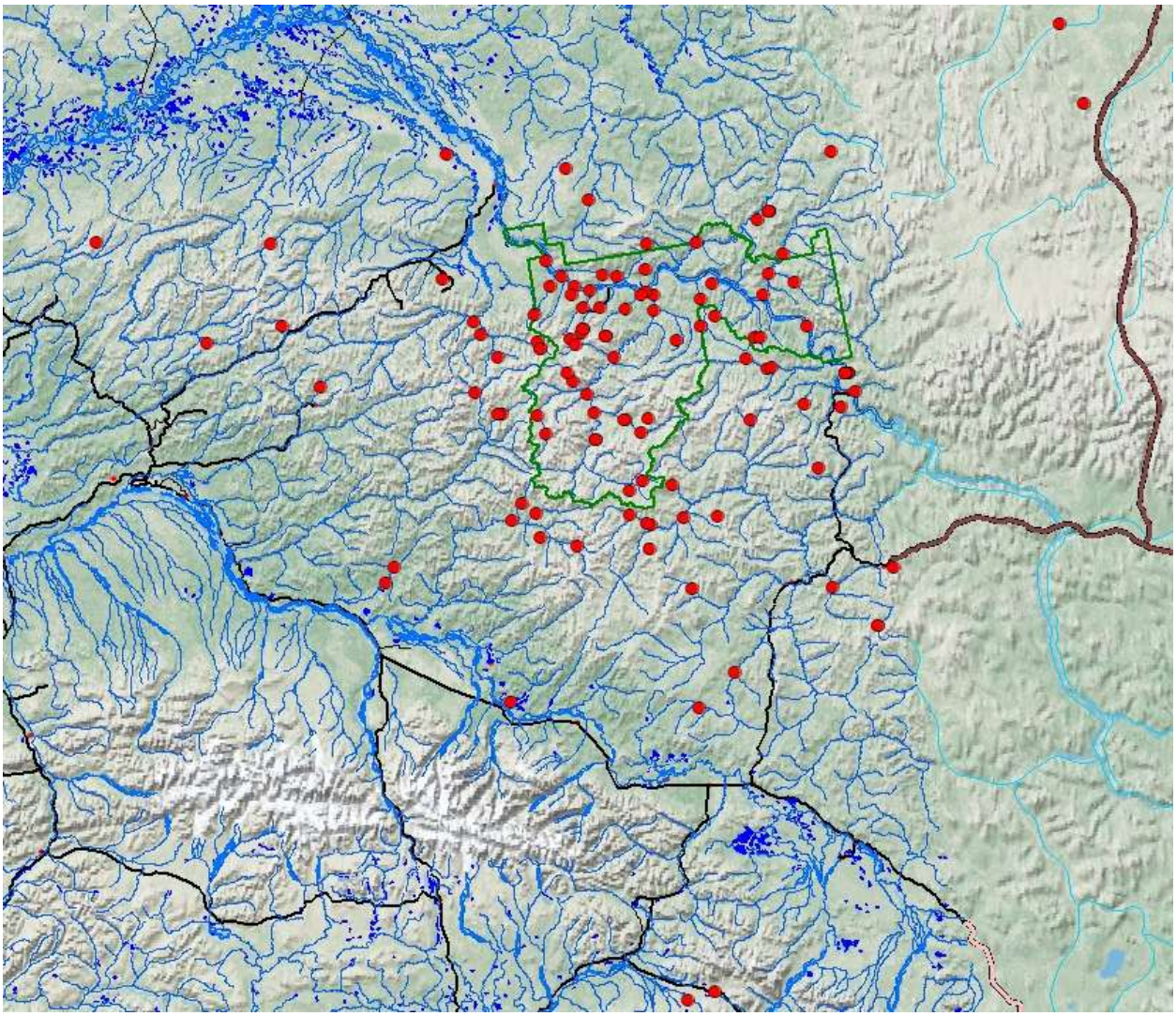

Figure 17. Locations of 124 known wolf mortalities from 1993 – 2012. Most wolf mortalities (102) were from radiocollared wolves. The more distant locations are wolves that dispersed before they died.

Wolf Harvest

The wolf hunting season in YUCH was extended in 2008, and now runs from August 10 – May 31 with a bag limit of 5 wolves south of the Yukon River in GMU 20, and 10 wolves north of the Yukon in GMU 25. The trapping season runs from Oct 1 (GMU 20) or Nov 1 (GMU 25) to April 30 with no bag limit. NPS is looking at returning the wolf hunting and trapping season back to ending on April 30. Even with these liberal regulations, few wolves are harvested in or near YUCH during most winters. Based on ADF&G sealing records, human harvest of wolves by conventional methods (not including wolf control) from within the preserve has averaged just under 7 wolves per year over the past 27 years (Figure 18). This harvest is about 15% of the YUCH fall wolf population which includes an added 8% for lone wolves dispersing into the population. Lone wolves are known to make up a high percentage of the harvested wolves for an area (Adams et. al. 2008). This level of harvest likely has had little impact on wolf population change in YUCH, and is probably mostly compensatory, removing wolves that would have died anyway (Burch 2002).

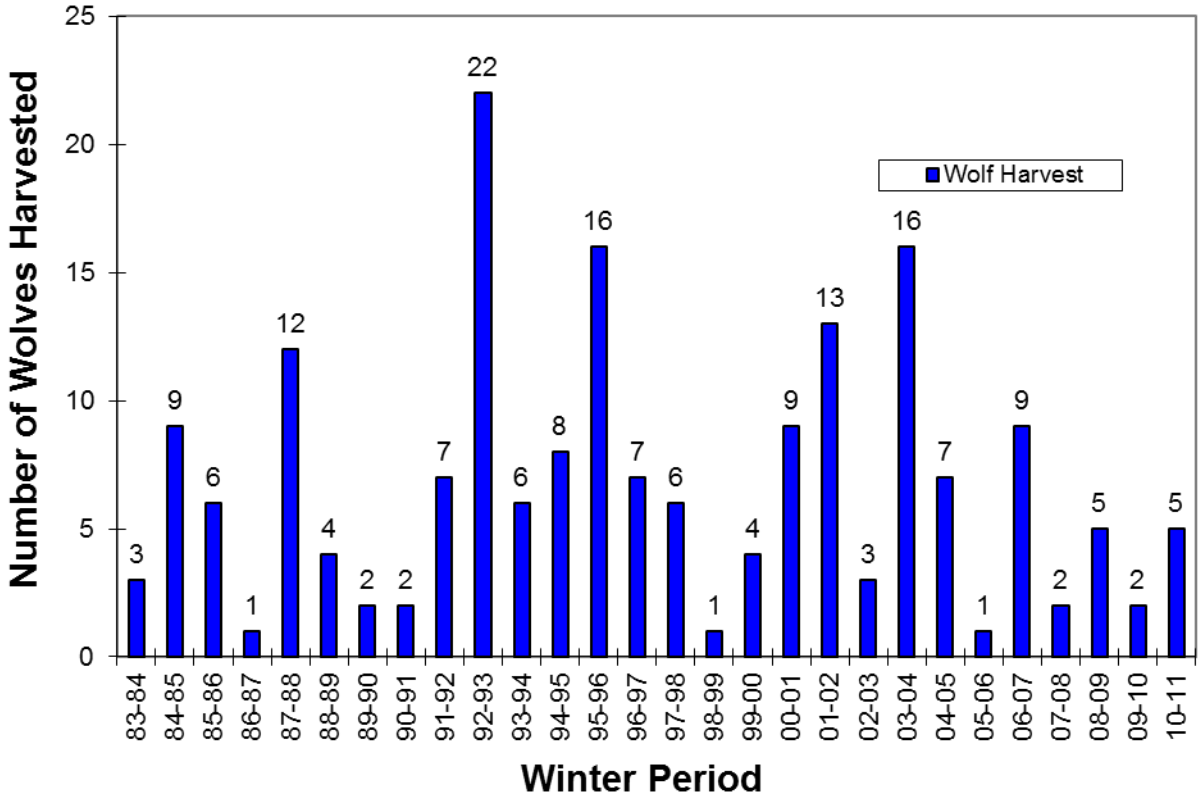

Figure 18. Harvest of wolves primarily within YUCH (Total wolves harvested in the Universal Coding Units (UCUs) that comprise Yuch), 1984 - 2011. From ADF&G wolf sealing records. 27 year average = 6.71.

ADF&G predator control in the UYTPCA

All preserve packs travel outside the boundaries of YUCH, many extensively (Figure 3 - 6). As a result, regulations regarding wolf management outside YUCH's boundary affect the entire wolf population utilizing preserve lands. In 2004 to 2006, the Alaska Board of Game made a series of

decisions (reflected in the State of Alaska statutes that promote sustained yield of a species such as caribou or moose) to conduct wolf control up against most of YUCH's boundary south of the Yukon River (Figure 3 – 6, 19). However, winters 2006-07 and 2007-08 had poor snow and weather conditions for snow tracking wolves, resulting in very few wolves being killed in the Fortymile Control efforts in those years (58 in 2005-06, 13 in 2006–07, and 27 in 2007-08). Control efforts fell far below the goal of reducing the entire population to somewhere between 88 - 103 wolves.

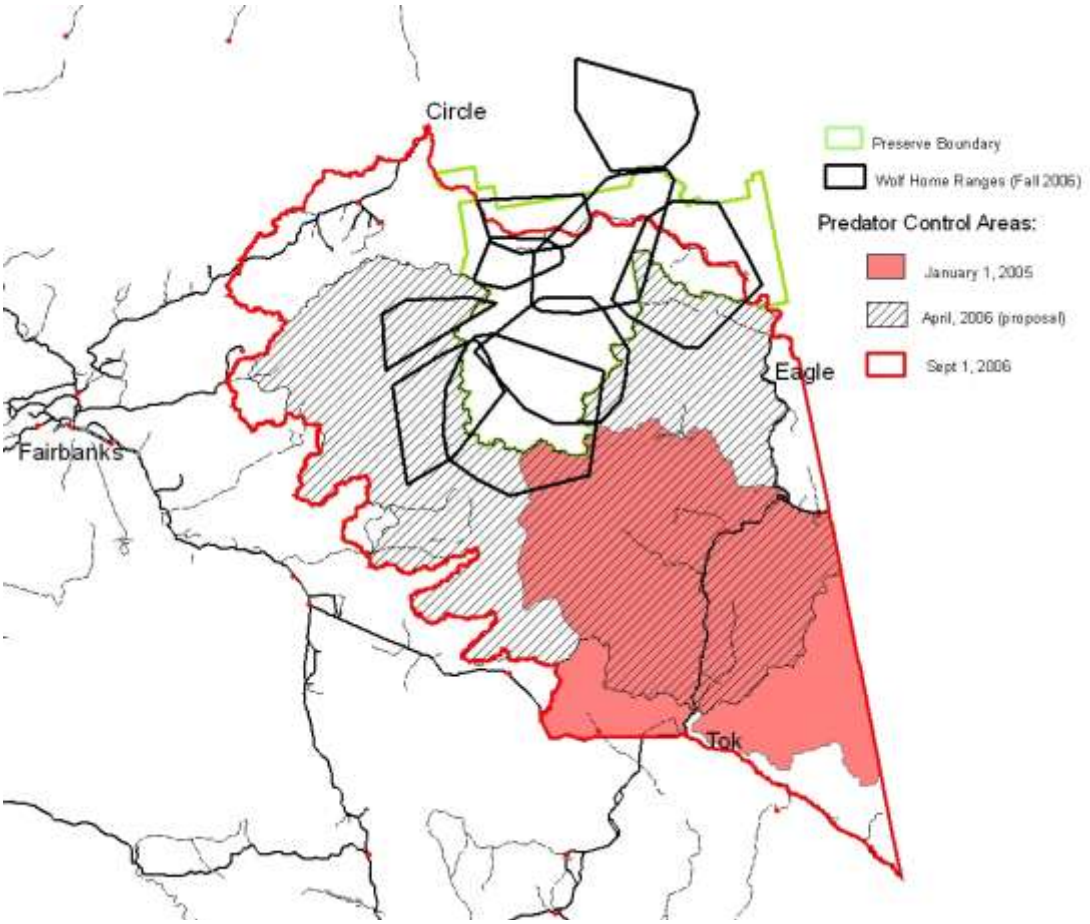

Figure 19. Map depicting the history and progression of wolf control boundaries relative to YUCH. UYTPCA (Upper Yukon Tanana Predator Control Area) = 48,550 km^2 (red line) has been in effect since Sept 2006.

The situation changed in winter 2008-2009, when good snow tracking conditions existed for much of the area, resulting in 49 wolves being shot from permitted fixed-wing airplanes. Furthermore, ADF&G implemented helicopter-based wolf control in March 2009 throughout the Upper Yukon Tanana Predator Control Area (UYTPC), excluding YUCH. A total of 84 wolves were shot from a helicopter in this portion of the control effort. However, none of the killed wolves were documented to have come from radiocollared packs that utilize YUCH lands (Figure 20). Another 87 wolves were harvested by conventional hunting and trapping, for a total of 220 wolves killed within UYTPCA during the 2008-09 season.

During winter 2009 – 2010, ten wolves were shot from fixed wing aircraft and 15 were shot from helicopters by ADF&G, and 35 by conventional hunting and trapping in the UYTPCA for a total of 60, considerably fewer than the previous years' 220 wolves taken.

On 17 March 2010, during the helicopter control efforts by ADF&G staff, all four wolves of the newly collared Webber Creek pack were shot from a helicopter just outside of the preserve boundary. The two collared and two uncollared wolves shot from the Webber Creek Pack were 4 of the 15 that were shot from helicopters in 2010. Information on the number of wolves killed in the UYTPCA for winter 2010 – 2011, and 2011 – 2012 are available at: http://www.adfg.alaska.gov/index.cfm?adfg=intensivemanagement.unit_12_20b_20d_20e_25c#anchor. And include for winter 2010 – 2011, 25 wolves shot from fixed-wing, 0 from helicopter and 37 by conventional means for a total of 62 in the control area. Winter 2011 – 2012 had 56 wolves shot from helicopter, 8 from fixed wing and 81 by conventional hunting and trapping for a total of 145.

On March 17, 2012 8 wolves of the Lost Creek Pack were shot from a helicopter and were the only known Yuch wolves killed in the States wolf control efforts. There were a total of 64 wolves killed in 2012 in the control area, 56 from helicopter, 8 from fixed wing (Figure 20).

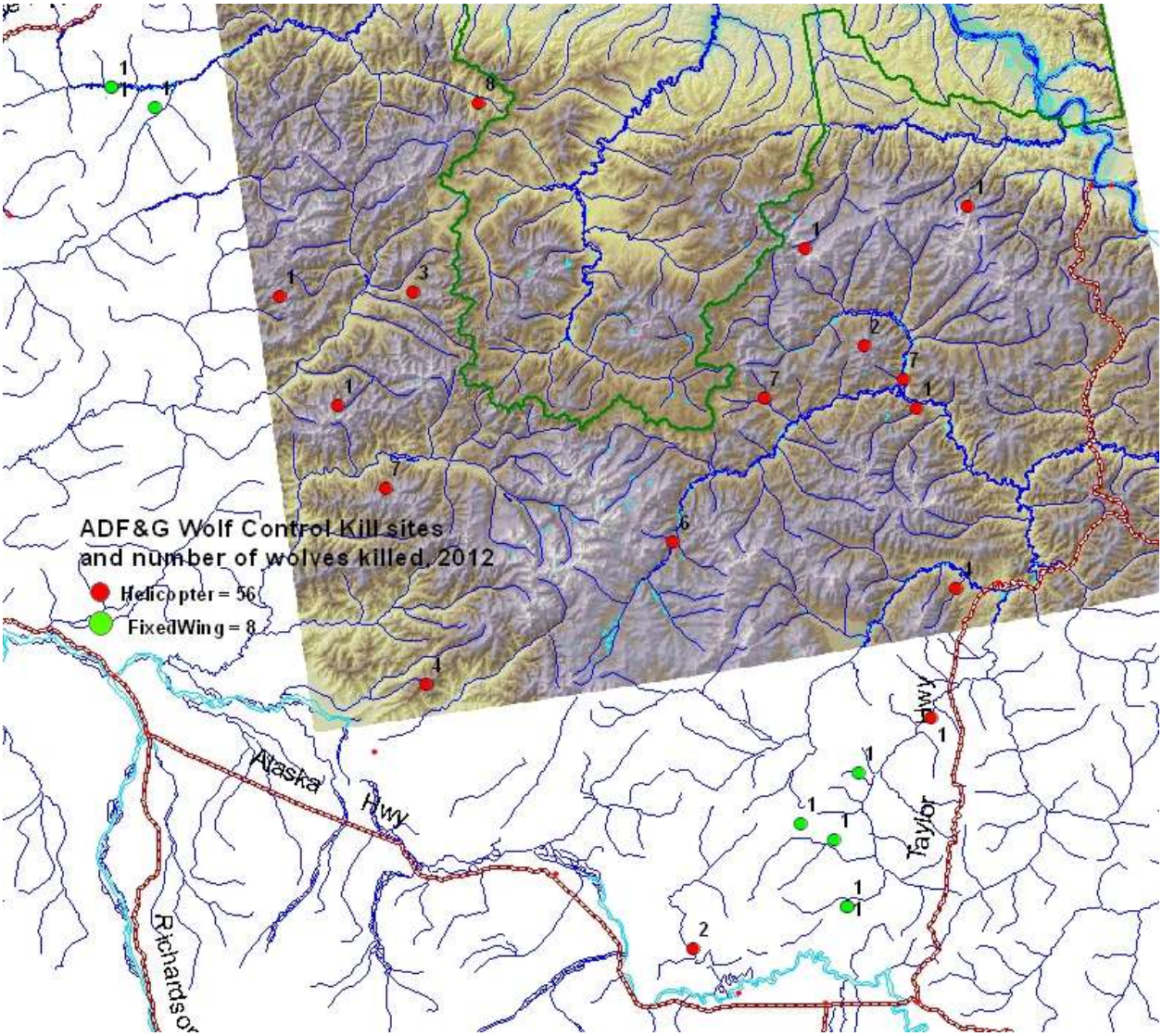

Figure 20. 2012 UYTPCA map of the location and number of wolves killed by ADF&G shooting from a helicopter, and private airplanes. Eight wolves from the Lost Creek Pack were shot just outside the Preserve in upper Yukon Fork. Data was provided to NPS courtesy of ADF&G.

Plans for the coming year

In November 2012 and February 2013, we plan to capture more wolves to maintain 2 or 3 collars in each pack, and to search for and capture wolves from any new or uncollared packs using Preserve lands. During this same time we will also be radiotracking collared wolves from aircraft to get accurate pack counts for fall and spring population estimates. During Spring and Fall of each biological year, collared wolves will be radiotracked 5 – 10 times to generate biannual population estimates and estimate pup production and survival.

Literature Cited

Adams, L.G., R.O. Stephenson, B.W. Dale, R.T. Ahgook, and D.J. Demma. 2008. Population dynamics and harvest characteristics of wolves in the Central Brooks Range, Alaska. Wildlife Monographs 170: 1-25.

Boertje, R.D., C.L.Gardner, K.A. Kellie, and B.D. Taras. 2012. Fortymile caribou herd: Increasing numbers, declining nutrition, and expanding range. Alaska Department of Fish and Game, Wildlife Technical Bulletin 14, ADF&G/DWC/WTB-2012-14. Juneau, Alaska.

Boertje, R. D. and C. L. Gardner. 1996. Factors limiting the Fortymile caribou herd. Alaska Dept. Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Project W-24-4. Juneau.

Burch, J. W. 2002. Ecology and demography of wolves in Yukon-Charley Rivers National Preserve, Alaska. NPS Technical Report NPS/AR/NRTR-2001/41. 72pp.

Burch, J. W. 2006. Annual report on vital signs monitoring of distribution and abundance of wolves in Yukon-Charley Rivers National Preserve. Central Alaska Network, March 2006. NPS Fairbanks. 14pp.

Burch, J. W. 2007. Annual report on vital signs monitoring of distribution and abundance of wolves in Yukon-Charley Rivers National Preserve. Central Alaska Network. NPS Fairbanks. 15pp.

Burch, J. W. 2008. Annual report on vital signs monitoring of wolf (*Canis lupus*) distribution and abundance in Yukon-Charley Rivers National Preserve, Central Alaska Network: 2008 report. Natural Resource Technical Report NPS/CAKN/NRTR—2008/149. National Park Service, Fort Collins, Colorado.

Burch, J. W. 2009. Annual report on vital signs monitoring of wolf (*Canis lupus*) distribution and abundance in Yukon-Charley Rivers National Preserve, Central Alaska Network: 2009 report. Natural Resource Technical Report NPS/CAKN/NRTR—2009/228. National Park Service, Fort Collins, Colorado.

Burch, J. W. 2010. Annual report on vital signs monitoring of moose (*Alces alces*) distribution and abundance in Yukon-Charley Rivers National Preserve, Central Alaska Network: November 2009 survey report. Natural Resource Technical Report NPS/CAKN/NRTR—2010/331. National Park Service, Fort Collins, Colorado.

Burch, J. W., L. G. Adams, E. H. Follmann, and E. A. Rexstad. 2005. Evaluation of wolf density estimation from radiotelemetry data. Wildlife Society Bulletin 33(4):1225-1236

Fuller, T. K., L. D. Mech, and J. F. Cochrane. 2003. Wolf population dynamics. Pp. 161-191 *In* Mech, L.D., and L. Boitani, eds., Wolves: Behavior, Ecology, and Conservation. University of Chicago Press. 448 pp.

Gese, E. M. and L. D. Mech. 1991. Dispersal of wolves (Canis lupus) in northeastern Minnesota, 1969 – 1989. Canadian Journal of Zoology 69:2946-55.

Mech L. D., L. G. Adams, T. J. Meier, J. W. Burch, B. W. Dale. 1998. The wolves of Denali. University of Minnesota Press, Minneapolis, Minnesota.

Mech, L. D., and S. M. Barber. 2002. A critique of wildlife radio-tracking and its use in National Parks. A report to the U. S. National Park Service.

Mech, L. D., and R. O. Peterson. 2003. Wolf-prey relations. Pp. 131-160 *In* Mech, L.D., and L. Boitani, eds., Wolves: Behavior, Ecology, and Conservation. University of Chicago Press. 448 pp.

Meier, T. J., Burch, J. W., Wilder, D., Cook, M. 2009. Wolf monitoring protocol for the Central Alaska Network, Alaska. Natural Resource Report NPS. National Park Service, unpublished protocol.

Miller, B., B. Dugelby, D. Foreman, C. Martinez del Rio, R. Noss, M. Phillips, R. Reading, M. E. Soule', J. Terborgh, and L. Willcox. 2001. The importance of large carnivores to health ecosystems. Endangered species Update 18: 202-210.

Murie, O. J. 1935. Alaska-Yukon caribou. North America Fauna No. 54. U. S. Department of Agriculture, Washington DC. 93pp.

National Park Service, 2001. Denali National Park and Preserve subsistence management plan. National Park Service, Denali Park, Alaska.

Ripple, W. J., and R. L. Beschta. 2003. Wolf reintroduction, predation risk, and cottonwood recovery in Yellowstone National Park. Forest Ecology and Management 184: 299-313.

Valkenburg P., D. G. Kelleyhouse, J. L. Davis, and J. M. Ver Hoef. 1994. Case history of the Fortymile caribou herd, 1920-1990. Rangifer 14: 11-22.

White, G.C. and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego, California.

Worton, B. J. 1989. Kernel methods for estimating the utilization distribution in home-range studies. Ecology 70:164-168.

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